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(71) Applicant(s)
Lisco Inc

(Incorporated in USA - Delaware)

601 S Harbour Island Boulevard, Suite 200, Tampa, Florida 33602-3141, United States of America

(72) Inventor(s)
Michael J Sullivan
Thomas J Kennedy

(74) Agent and/or Address for Service
Swann, Elt & Co
31 Beaumont Street, OXFORD, OX1 2NP, United Kingdom

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(54) Method of improving scuff and cut resistance of ionomer covered game ball

(57) A game ball has an ionomeric cover 12 which comprises a combination of ionomeric crosslinks and covalent crosslinks. The game ball cover is superior in at least one of cut resistance and scuff resistance to a conventional cover that does not have covalent crosslinks but is otherwise substantially identical in composition. The game ball cover is particularly useful for improving the durability of golf balls to be struck with sharp-grooved clubs. The crosslinking may comprise radiation-induced crosslinking.

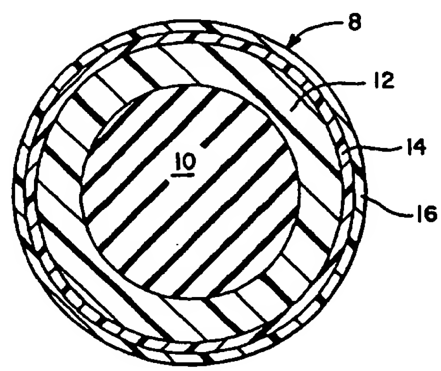

FIG. 1

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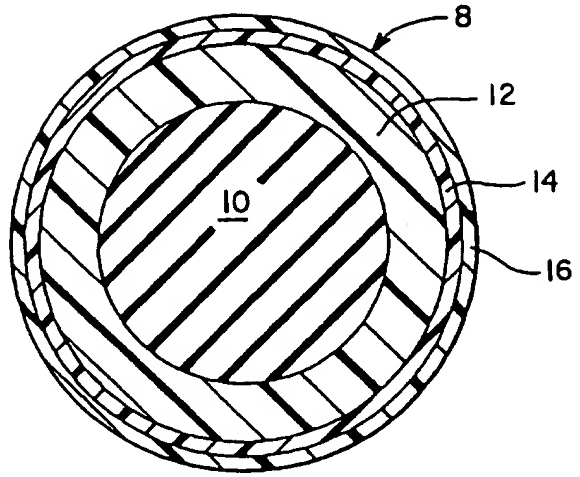

FIG. 1

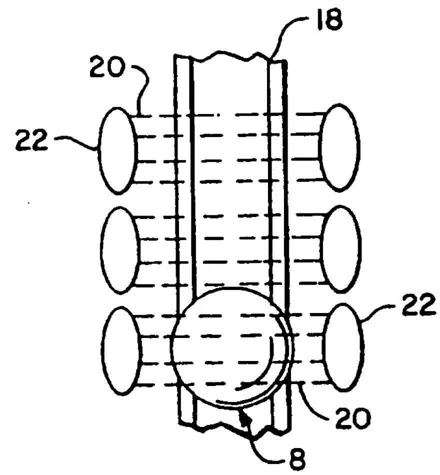

FIG. 2

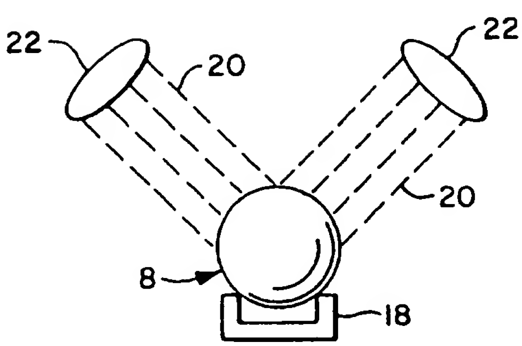

FIG. 3

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METHOD OF IMPROVING SCUFF AND CUT RESISTANCE OF IONOMER COVERED GAME BALL

This invention relates generally to balls, and more particularly to a game ball having an ionomeric cover, for example a golf ball.

Before the development of ionomers, balata was the preferred material for golf ball covers. Polyethylene also was proposed for use as a golf ball cover material but was generally deemed highly inferior to balata in imparting playability and durability characteristics to the ball, due to its brittleness and high hardness, and thus never became a commercially successful golf ball cover material.

Balata golf ball covers have now been replaced to a great extent by ionomeric cover materials. Ionomers may be copolymers of an olefin and an α, β-ethylenically unsaturated carboxylic acid with a portion of the carboxylic acid groups neutralized by a metal ion. The metal ions serve as crosslinking agents, because they are ionically bonded to carboxylic acid groups in adjacent copolymer chains. Instead of having thermally irreversible covalent bonding, ionomers have thermolabile crosslinking in which metal ions become part of the chemical structure of the ionomer upon

crosslinking, and these crosslinks are reversible. For purposes of the present application, this type of crosslinking is referred to as ionic crosslinking. One of the advantages of ionic crosslinking in golf ball materials is the ability of ionic bonds to re-form after breaking as a result of processing at elevated temperatures.

There are numerous advantages to the use of ionomers in making golf ball covers. On the other hand, one drawback of conventional golf balls with soft ionomeric covers is that the covers are prone to scuffing and cutting, particularly when hit with irons which have sharp grooves. It would be useful to develop a golf ball with a soft ionomeric cover which is highly resistant to cutting and scuffing by sharp-grooved clubs.

Some examples of the present invention are mentioned below.

One object of the invention is to provide an ionomeric game ball cover having improved scuff resistance and/or cut resistance.

Another object of the invention is to provide a method for imparting improved scuff resistance and/or cut resistance to a game ball cover.

Yet another object of the invention is to provide a golf ball with a soft cover which is well suited for use with golf club irons having sharp grooves.

Yet another object of the invention is to provide a method of forming a golf ball with a soft cover which has excellent scuff resistance and/or cut resistance.

A first aspect of the present invention provides a ball, comprising:

a cover comprising at least one ionomer resin that comprises copolymer of olefin and α, β-ethylenically unsaturated carboxylic acid that is sufficiently neutralized with metal ions so as to have a sufficient degree of covalent crosslinking to impart to the cover an increased resistance to at least one of scuffing and cutting.

In said first aspect of the invention, said ball may be a game ball, for example, a golf ball. Said cover may have a dimpled surface. Said degree of covalent crosslinking may be sufficient to impart to the cover a Shore D hardness at most 10% greater than the Shore D hardness of a cover having a substantially identical composition but which does not have a substantial degree of covalent crosslinking. Said

degree of covalent crosslinking may be sufficient to impart to the cover a Shore D hardness at most 5.0% greater than the Shore D hardness of a cover having a substantially identical composition but which does not have a substantial degree of said covalent crosslinking. Said degree of covalent crosslinking may be sufficient to impart to the ball a PGA compression at least 5% harder than the PGA compression of a ball with a cover having a substantially identical composition but which does not have a substantial degree of covalent crosslinking. Said degree of covalent crosslinking may be sufficient to impart to the ball a coefficient of restitution at least 0.50% greater than a coefficient of restitution of a ball with a cover having a substantially identical composition but which does not have radiation-induced covalent crosslinking. Said copolymer may have radiation-induced covalent crosslinking to increase the resistance of the cover to at least one of scuffing and cutting. Said radiation-induced covalent crosslinking may be provided by irradiating the cover by a method comprising utilising an electron beam. Said irradiation may comprise electron beam dosage of at least 1 megarads.

Said irradiation may be before and/or after application of coating over the cover. After said

irradiation, a top coating may be applied to the irradiated cover. Said copolymer may further comprise acrylate. Said neutralization of said carboxylic acid may correspond to 10 to 100% neutralization with said metal ions. Said cover may have a Shore D hardness of at most 65.

A second aspect of the present invention provides a method of forming a ball of said first aspect of the present invention.

The invention in one preferred form is a game ball having a cover comprising an ionomer resin. The ionomer resin may comprise a copolymer of an olefin and an α, β-ethylenically unsaturated carboxylic acid which is 10-100% neutralized with metal ions. The copolymer has a sufficient degree of covalent crosslinking to impart to the cover improved resistance to at least one of scuffing and cutting. In a particularly preferred form of the invention, the game ball is a golf ball. Preferably, the game ball has a dimpled surface. The covalent crosslinking preferably comprises irradiation-induced covalent crosslinking.

In another form of the invention, the degree of covalent crosslinking is appropriate to impart to the cover a Shore D hardness which is no more than 10% greater, and more preferably no more than 5% greater,

than the Shore D hardness of a cover having an identical composition but which does not comprise a substantial degree of covalent crosslinking. Preferably, the copolymer further comprises acrylate.

Another aspect of the invention is a method of forming a game ball having a cover comprising an ionomer, said method comprising irradiating the ionomer in the cover under conditions appropriate to covalently crosslink the ionomer in order to increase the resistance of the cover to at least one of scuffing and cutting without substantially impairing other playability characteristics of the ball.

In a particularly preferred form of the invention, the game ball is a golf ball. Preferably, the game ball has a dimpled surface.

In one preferred form of said method of the invention, a game ball is subjected to irradiation comprising electron beam treatment at a dosage of at least 1 megarads. The game ball cover preferably is irradiated prior to application of a top coat over a cover. The method of the invention preferably further comprisesthe step of applying a top coat over the cover before or after irradiation.

The present invention is exemplified by the following detailed disclosure with reference to the

accompanying drawings wherein:

Fig. 1 shows one example of a golf ball according to the present invention.

Figs. 2 and 3 schematically show one example for practicing the method of the present invention.

The game balls of the present invention are surprisingly superior in their scuff (abrasion) resistance and cut resistance to conventional game balls which have not been electron beam treated, and which contain similar quantities of ionomer and have a similar hardness. Furthermore, the golf balls and other game balls of the invention are comparable in scuff and cut resistance to game balls having non-ionomeric compositions, such as polyurethanes, with similar properties of compression, coefficient of restitution (COR), and hardness.

The game balls of the present invention may be formed by first obtaining an uncoated or coated game ball having an ionomeric cover. An "uncoated" game ball as the term is used in this application is a one, two, or multi-piece game ball to which no primer or top coat has been applied over the ionomeric cover. In contrast, a "coated" game ball as this term is used in this application is a ball which has a primer coat and/or a top coat over the ionomeric cover layer. The coated or

uncoated game ball of the invention may be subjected to irradiation under conditions appropriate to induce covalent crosslinking of the ionomer. This type of direct covalent bonding has been found to take place in ionomeric cover materials when electron beam treatment is applied at a dosage of 2 or more megarads and is expected to also be useful at lower dosages, for example, 1 megarad.

For clarity of description and ease of understanding, the invention will be described in connection with golf balls although it will be understood that other game balls, for example softballs, basketballs, baseballs, soccer balls, vollyballs, street hockey balls, footballs, etc. can advantageously employ the features of the present invention.

Referring now to the drawings, and in particular to Fig. 1, one example of a golf ball according to the present invention is shown and is designated as 8. The ball has a core 10, which is solid, or is formed from any other suitable type of core composition. An ionomeric cover 12 surrounds the core 10. A thin primer coat 14 is applied to the outer surface of cover 12. A thin top coat 16 surrounds the primer coat 14. The thicknesses of primer coat 14 and top coat 16 are exaggeratedfor illustrative purposes.

In accordance with the present invention, after the cover layer 12 is applied over the core, the cover layer 12 is subjected to irradiation at a dose of about 1 or more megarads in order to covalently crosslink the ionomeric cover material. Particularly good results are obtained when the dosage is in the range of 2 - 12 megarads. In a most preferred form of the invenion, a dosage in the range of 4 - 8 megarads is utilized. AS used herein, the term "irradiation" may refer to short-duration irradiation using an electron beam or the like, rather than to mere exposure to sunlight, which would result in a dosage of well below 1 megarad. Irradiation takes place at a temperature below the melting or deformation temperature of the cover layer, and for convenience preferably takes place at ambient temperature.

The cover 12 can be irradiated prior to or after application of primer coat 14 and top coat 16. Furthermore, primer coat 14 can be eliminated if adhesion of top coat 16 to cover 12 is sufficient to render the ball suitable for competitive play, as is commonly the case with softballs and baseballs, and may also be the case for other game balls.

The game ball of the invention can be irradiated with electrons, neutrons, protons, gamma

rays, x-rays, helium nuclei, etc. In a particularly preferred form of the invention, the scuff and cut resistance of cover 12 is enhanced by subjecting the cover to electron beam treatment at a dosage sufffficient to significantly improve scuff resistance and COR without excessively hardening the compression. The game ball preferably obtains an improvement in COR of at least 0.5% as a result of irradiation of the cover.

The cover composition contains high quantities of ionomer. Thus, the irradiated cover material may have a combination of ionic crosslinks and covalent crosslinks. Particularly preferred ionomers or ionomer blends comprise ionic copolymers containing an olefin, an unsaturated carboxylic acid, and an acrylate. Such polymers may have a Shore D hardness in the range of 20 - 60. Non ionomeric materials can be blended with the ionomer as long as an acceptable increase in scuff resistance and/or cut resistance is obained as a result of covalent crosslinking of the ionomer. Some non-limiting examples of materials to be blended with an ionomer are ethylene-ethyl acrylate; ethylene-methyl acrylate; ethylene-vinyl acetate; low density polyethylene; linear low density polyethylene; metallocene catalyzed polyolefins such as ENGAGE polyolefins available from Dow Chemical and EXACT

polyolefins available from Exxon; non-ionomeric acid copolymers such as PRIMACOR available from Dow Chemical, and NUCREL available from Du Pont; and a variety of thermoplastic elastomers, e.g. KRATON available from Shell, SANTOPRENE available from Monsanto, and HYTREL, available from Du Pont, etc.

If the game ball cover is irradiated prior to application of a primer coat 14 and/or top coat 16, there is no particular restriction on the type of primer coat and/or top coat to be used. If irradiation occurs afer application of a primer coat and/or a top coat over the cover 12, it is important to ensure that the radiation will penetrate the coating, and that the dosage of radiation is sufficient to covalently crosslink the cover material without adversely affecting the properties of the primer and/or top coat to a substantial degree. Due to the thinness of the primer coat and top coat on most game balls, for example golf balls, it has been found that little change in radiation dosage is required if irradiation occurs after application of such coatings.

Golf balls according to the invention preferably have a post-irradiation PGA compression of in the range of 10 - 110. In a particularly preferred form of the invention,the golf balls have a PGA compression

of in the range of 40 - 100 after irradiation. It has been found that excellent results are obtained when the post-irradiation PGA compression of the golf balls is in the range of 60 - 100. The irradiation preferably results in an increase in PGA compression of at least 5% compared to the PGA compression of the ball prior to treatment. The coefficient of restitution of the golf balls of the invention after treatment may be in the range of .780 or greater. Preferably, the COR of the golf balls is in the range of .790 - .830 and most preferably in the range of .800 - .830. The Shore D hardness of the golf balls of the invention after irradiation may be in the range of 40 - 80. Particularly goods results are obtained when the Shore D hardness of the golf balls is in the range of 50 - 70, and most preferably in the range of 50 - 60.

The invention is particularly well suited for use in making dimpled, pebbled, and other game balls which do not have a smooth outer surface, for example game balls with simulated stitching. A smooth ball is less susceptible to scuffing than a dimpled ball since dimples give the golf club groove a sharp-edged surface to "catch." Pebbles clearly are susceptible to shearing when dribbled on a hard surface, or the like. Likewise on a molded-cover softball, the stitching is a raised

area that will be sheared or compressed more than the smooth-surfaced area by a bat and/or by the turf, dirt, etc.

One example of a method for electron beam treating golf balls according to the invention is described in connection with Figs. 2 and 3. The golf ball 8 is placed on a channel 18 along which it slowly moves. Electrons 20 from electron beam lamps 22 contact the surface of the ball 8. The lamps are positioned to provide a generally uniform dose of radiation on the entire surface of the ball as the ball rolls along the channel 18. Preferably, the balls are irradiated with an electron beam dosage of 1 or more megarads, more preferably in the range of 2 - 12 megarads. The intensity of the dosage preferably is in the range of 1 - 20 MeV.

The golf balls of the invention are found to exhibit a post-treatment scuff resistance in the range of 1 - 3 on a scale of 1 - 4. It is preferred that the treatment be appropriate to provide the golf balls with a scuff resistance in the range of 1 - 2.5, and more preferably in the range of 1 - 2. Golf balls according to the invention may have a cut resistance in the range of 1 - 3 on a scale of 1 - 5. It is preferred that the golf balls of the invention have a cut resistance in the range of 1 -2.5 and most preferably in the range of 1-2.

The scuff resistance test was conducted in the following manner:

a Top-Flite pitching wedge (1994) with box grooves was obtained and was mounted in a Miyamae driving machine. The club face was oriented for a square hit. The forward/backward tee position was adjusted so that the tee was 10.16 cm (four inches) behind the point in the downswing where the club was vertical. The height of the tee and the toe-heel position of the club relative to the tee were adjusted in order that the center of the impact mark was 1.905 cm (3/4 of an inch) above the sole and was centered toe to heel across the face. The machine was operated at a clubhead speed of 38.1 meters per second (125 feet per second). Three samples of each ball were tested. Each ball was hit three times. After testing, the balls were rated according to the following table:

Rating	Type of damage
1	Little or no damage (groove markings or dents)
2	Small cuts and/or ripples in cover
3	Moderate amount of material lifted from ball surface but still attached to ball

4	Material removed or barely attached

Cut resistance was measured in accordance with the following procedure: a golf ball was fired at 41.148 meters per second (135 feet per second) against the leading edge of a 1994 Top-Flite Tour pitching wedge, wherein the leading edge radius is 0.079 cm (1/32 inch), the loft angle is 51 degrees, the sole radius is 6.35 cm (2.5 inches), and the bounce angle is 7 degrees.

The cut resistance of the balls tested herein was evaluated on a scale of 1 -5. A 5 represents a cut that extends completely through the cover to the core; a 4 represents a cut that does not extend completely through the cover but that does break the surface; a 3 does not break the surface of the cover but does leave a permanent dent; a 2 leaves only a slight crease which is permanent but not as severe as 3; and a 1 represents virtually no visible indentation or damage of any sort.

It has been found that golf balls which are treated according to the irradiation technique of the present invention exhibit a particular improvement in scuff and/or cut resistance. This improvement is particularly significant when the golf balls are struck with a square-grooved iron. It has been found that square-grooved irons and other sharp-grooved irons tend

to abrade and damage golf ball covers more readily than irons having "V-type" grooves.

Having generally described the invention, the following detailed examples are included for purposes of illustration so that the invention may be more readily understood and are in no way intended to limit the scope of the invention unless otherwise specifically indicated.

<u>Example 1</u>

Polybutadiene golf ball cores having an average coefficient of restitution (COR) of .790 and a PGA compression of 90 were obtained. The cores were covered with a relatively soft, 0.1397 cm (0.055 inch) thick cover formed from an ionomeric composition, designated as ionomer 1, which comprises a blend of a hard sodium ionomer and a soft zinc ionomer. Pigments and an optical brightener were also included in the cover composition. The hard ionomer is a copolymer containing two monomer types, namely an α-olefin and an acrylic-type carboxylic acid. The soft ionomer is a copolymer which contains three types of monomers, namely an α-olefin, an acrylic-type carboxylic acid, and an acrylate. The cover was formed over the core. The balls were primed with a polyurethane-based primer with a thickness of 0.0127 cm (0.5 thousandths of an inch) and coated with a polyurethane top coat with a thickness of 0.0127 cm (0.5 thousandths of an inch). The properties of these balls prior to electron beam treatment are shown in Table 1.

A portion of the balls were subjected to electron beam treatment at dosages of 2,4,6,8, and 11 megarads at an energy level of 10 MeV. Changes in the properties of the balls are shown in Table 1.

As indicated in Table 1, the scuff resistance of the golf balls substantially improved in the range of electron beam dosages of 2 to 6 megarads. The cut resistance of the balls improved in the range of electron beam dosages of 6 to 8 megarads. Meanwhile, the change in Shore D hardness in the dosage range of 2 to 8 was only 1.

TABLE 1

Cover Material	Dosage (Megarads)	Weight	PGA Comp	COR	Shore D	Scuff Resistance	Cut Resistance
Ionomer Blend 1	2.0	45.6	93	.788	54	2.5	2 - 3
(coated prior to	4.0	45.6	97	.797	55	1-2	2 - 3
treatment)	6.0	45.5	98	.795	55	1.5	2 - 3
	8.0	45.6	98	.797	55	1.5	2
	11.0	45.6	101	.802	55	1.5	2
	0	45.6	92	.787	54	3.5	3
Ionomer Blend 2	2.0	45.4	96	.822	63	- -	- -
(uncoated)	4.0	45.4	97	.822	63	- -	- -
	0	45.4	88	.812	62	- -	- -
Ionomer Blend 2	6.0	45.6	101	.829	64	1.5	1 - 2
(coated with	8.0	45.5	103	.828	64	1.5	1 - 2
primer and top	0	45.6	88	.813	63	2.0	1 - 2
coat prior to							
treatment)							

(Weight = Ball weight, grams)

<u>Example 2</u>

Golf ball cores having an average PGA compression of 85 and an average COR of .800 were obtained. The cores were covered with a hard zinc-sodium ionomeric composition containing two monomer types, namely an α-olefin and a carboxylic acid. The initial properties of the covered cores prior to priming and finish coating are shown in Table 1.

A portion of the golf balls were painted with the same polyurethane-based primer as was used in Example 1 and then coated with the same polyurethane top coat as was used in Example 1. Subsequently, a portion of both the unprimed and unfinished golf balls and the primed and finished golf balls were subjected to electron beam treatment in the dosages shown in Table 1. Properties of compression, COR, Shore D hardness and scuff resistance are shown in Table 1.

As indicated in Table 1, the scuff resistance of the finished golf balls increased substantially while resulting in a minimal increase in Shore D hardness.

In this specification(description, claims and abstract), precise values include values about or substantially the same as precise values, e.g. 10% includes values about or substantially the same as 10%.

Imperial values include their metric values. The present disclosures include the whole of the description, the appended claims, the appended drawings, and the appended abstract; and modifications or equivalents thereof.

As will be apparent to persons skilled in the art, various modifications and adaptations of the structure above described will become readily apparent without departure from the spirit and scope of the invention, the scope of which is defined in the appended claims.

CLAIMS

1. A ball, comprising:

a cover comprising at least one ionomer resin that comprises copolymer of olefin and α,β-ethylenically unsaturated carboxylic acid that is sufficiently neutralized with metal ions so as to have sufficient degree of covalent crosslinking to impart to the cover an increased resistance to at least one of scuffing and cutting.

2. A ball as claimed in claim 1, wherein the ball is a game ball.

3. A ball as claimed in claim 2, wherein the game ball is a golf ball.

4. A ball as claimed in any one of claims 1 to 3, wherein the cover has a dimpled surface.

5. A ball as claimed in any one of claims 1 to 4, wherein said degree of covalent crosslinking is sufficient to impart to the cover a Shore D hardness at most 10% greater than the Shore D hardness of a cover having a substantially identical composition but which does not have a substantial degree of covalent crosslinking.

6. A ball as claimed in any one of claims 1 to 5, wherein said degree of covalent crosslinking is sufficient to impart to the cover a Shore D hardness at most 5.0% greater than the Shore D hardness of a cover having a substantially identical composition but which does not have a substantial degree of said covalent crosslinking.

7. A ball as claimed in any one of claims 1 to 6, wherein the degree of covalent crosslinking is sufficient to impart to the ball a PGA compression at least 5% harder than the PGA compression of a ball with a cover having a substantially identical composition but which does not have a substantial degree of covalent crosslinking.

8. A ball as claimed in any one of claims 1 to 7, wherein said degree of covalent crosslinking is sufficient to impart to the ball a coefficient of restitution at least 0.50% greater than a coefficient of restitution of a ball with a cover having a substantially identical composition but which does not have radiation-induced covalent crosslinking.

9. A ball as claimed in any one of claims 1 to 8, wherein said copolymer has radiation-induced covalent crosslinking to increase the resistance of the cover to at least one of scuffing and cutting.

10. A ball as claimed in claim 9, wherein said radiation-induced covalent crosslinking has been provided by irradiating the cover by a method comprising utilising an electron beam.

11. A ball as claimed in claim 10, wherein said irradiation is at least 1 megarads.

12. A ball as claimed in claim 11, wherein said irradiation is at least 2 megarads.

13. A ball as claimed in 12, wherein said irradiation is in the range 2 to 12 megarads.

14. A ball as claimed in claim 13, wherein said irradiation is in the range 2 to 6 megarads.

15. A ball as claimed in claim 13, wherein said irradiation is in the range 4 to 8 megarads.

16. A ball as claimed in claim 13, wherein said irradiation is in the range 6 to 8 megarads.

17. A ball as claimed in any one of claims 9 to 16, wherein the irradiation has an intensity in the range of 1 to 20 MeV.

18. A ball as claimed in any one of claims 9 to 17, wherein said irradiation was applied before and / or after application of at least one coating over the cover.

19. A ball as claimed in any one of claims 9 to 18, wherein after said irradiation top coating was applied to the irradiation cover.

20. A ball as claimed in any one of claims 1 to 19, wherein said copolymer further comprises acrylate.

21. A ball as claimed in any one of claims 1 to 20, wherein said neutralization of said carboxylic acid corresponds to 10 to 100% neutralization with said metal ions.

22. A ball as claimed in any one of claims 1 to 21, wherein the cover has a Shore D hardness of at most 65.

23. A ball as claimed in claim 1, substantially as hereinbefore described with reference to the accompanying drawings.

24. A ball as claimed in claim 1, substantially as described in the Examples.

25. A game ball having a cover comprising an ionomer resin, the ionomer resin comprising copolymer of olefin and α, ß-ethylenically unsaturated carboxylic acid which is 10 - 100% neutralized with metal ions, the copolymer having a sufficient degree of covalent crosslinking to impart to the cover improved resistance to at least one of scuffing and cutting.

26. A game ball according to claim 25, wherein the game ball is a golf ball.

27. A game ball according to claim 25, wherein the cover has a dimpled surface.

28. A game ball according to claim 25, wherein the covalent crosslinking comprises radiation-induced covalent crosslinking.

29. A game ball according to claim 25, wherein the degree of covalent crosslinking is appropriate to impart to the cover a Shore D hardness which is no more than 10% greater than the Shore D hardness of a cover having a substantially identical composition but which does not include a substantial degree of covalent crosslinking.

30. A game ball according to claim 25, wherein the copolymer furher comprises an acrylate.

31. A game ball according to claim 25, wherein the cover has a Shore D hardness of 65 or less.

32. A game ball according to claim 28, wherein the degree of covalent crosslinking is sufficien to impart to the ball a coefficient of restitution which is at least 0.50% greater than a coefficient of restitution of a ball with a cover having a substantially identical composition but which does not have radiation-induced covalent crosslinking.

33. A game ball according to claim 26, wherein the degree of covalent crosslinking is sufficient to impart to the ball a PGA compression which is at least 5% harder than the PGA compression of a golf ball with a cover having a substantially identical composition but which does not have a substantial degree of covalent crosslinking.

34. A game ball having a cover comprising ionomer resin, the ionomer resin comprising copolymer of α-olefin, acrylate, and α,β-ethylenically unsaturated carboxylic acid which is 10 - 100% neutralized with metal ions, the copolymer having a degree of radiation induced covalent crosslinking which is sufficient to substantially improve the resistance of the cover to a least one of scuffing and cutting while resulting in a cover hardness (Shore D) which is no more

than 5.0% higher than the Shore D hardness of a cover which is substantially identical in composition but does not contain covalent crosslinking.

35. A game ball according to claim 34, wherein the game ball is a golf ball.

36. A game ball according to claim 34, wherein the cover has a dimpled surface.

37. A method of forming a ball optionally a game ball, comprising:
obtaining a game ball having a cover comprising an ionomer;
and
irradiating the ionomer in the cover under conditions appropriate to covalently crosslink the ionomer in order to increase the resistance of the cover to at least one of scuffing and cutting without substantially impairing other playability characteristics of the ball.

38. A method according to claim 37, wherein the game ball is a golf ball.

39. A method according to claim 37, wherein the game ball has a dimpled surface.

40. A method according to claim 37, wherein the cover is irradiated using an electron beam.

41. A method according to claim 40, wherein the cover is subjected to electron beam treatment at a dosage of at least 2 megarads.

42. A method according to claim 37, wherein the game ball cover is irradiated after application of a coating over the cover.

43. A method according to claim 37, comprising the step of applying a top coating over the cover after irradiation.

44. A method according to claim 37, wherein the ionomer comprises copolymer of α-olefin, acrylate, and α,β-ethylenically unsaturated carboxylic acid which is 10 - 100% neutralized with metal ions.

45. A method of forming a game ball, comprising: obtaining an unfinished game ball having a cover comprising an ionomer;
forming a coating over the cover; and
irradiating the ionomer in the cover at a dosage of at

least 2 megarads to covalently crosslink the ionomer to a degree sufficient to increase at least one of the scuff resistance and cut resistance of the cover without reducing the coefficient of restitution of the cover.

46. A method according to claim 45, wherein the game ball is a golf ball.

47. A method according to claim 45, wherein the game ball has a dimpled surface.

48. A method according to claim 45, wherein the ionomer comprises copolymer of α-olefin, acrylate, and α,β-ethylenically unsaturated carboxylic acid which is 10 - 100% neutralized with metal ions.

49. A method of forming a golf ball according to claim 1, said method being substantially as hereinbefore described with reference to the accompanying drawings.

50. A method of forming a golf ball according to claim 1, substantially as described in the Examples.

The Patent Office

30.

Application No: GB 9702144.8
Claims searched: 1-50

Examiner: Alan Kerry
Date of search: 25 April 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): C3J JAC, JCH; C3P PFE; C3V VEM

Int Cl (Ed.6): A63B 37/12; C08F 8/44, 122/02; C08J 3/28

Other: Online databases: WPI, CLAIMS

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	WPI Abstract Accession Number 88-060404/09 & JP 63 015832	1-3, 25, 37 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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